Short Communications

Woody canopy cover of the *Burkea* savanna at Nylsvley

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The woody plant canopy cover of the *Burkea* savanna was found to vary between 30 and 49% across the savanna study area. Areas which were burnt between 1976 and 1980 showed a decrease in canopy cover with a corresponding increase in woody plant density. In unburnt areas there was a positive correlation between canopy cover and density as both showed an increase over this time-period. The herbaceous plant cover was found to be inversely related to the woody plant cover in most areas but herbaceous plants appear to be more susceptible to fluctuating rainfall, which has been experienced during this period.

Die kroonbedekking van houtagtiges in die *Burkea*-savanne wissel tussen 30 en 49% oor die savanne-studiegebied. Die kroonbedekking in studiestroke wat tussen 1976 en 1982 afgebrand het, het verminder terwyl die plantdigtheid toegeneem het. 'n Positiewe korrelasie tussen bedekking en digtheid word in ongebrande studiestroke aangetoon, aangesien beide gedurende hierdie tydperk toegeneem het. In die meeste van die studiestroke is die bedekking van die kruidstratum in 'n omgekeerde verhouding tot die bedekking van houtagtiges aangesien kruidagtige plante meer sensitief blyk te wees vir wisselende reënval, wat gedurende hierdie tydperk ondervind was.

Keywords: Canopy cover, fire, Nylsvley, savanna

The Savanna Ecosystem Project on the Nylsvley Nature Reserve, 10 km south of Naboomspruit in the northern Transvaal has been in progress over 12 years now. The description and objectives of the project as defined by Anon. (1975), were to determine, in the preliminary phase, the structure and dynamics of the ecosystem as a whole. My project has revealed interesting facets of the dynamics of the woody plant component of the *Burkea* savanna (Lubke & Thatcher 1983) and has been extended to a study of the long-term changes. One important aspect that I have not previously reported, is the change in canopy cover of the woody component and the effect of the veld burning programme on plant cover. This note briefly describes these changes, also relating woody plant cover to that of the herbaceous layer as reported by Van Rooyen & Theron (1977, 1982).

Details of the methods used in the study of the woody plants have been well-documented (Lubke & Thatcher 1983; Lubke 1985) and are not repeated here. The 5 sample sites which were distributed across the study area are illustrated in Figure 1 and it is in each of these areas that periodic (2 – 4-yearly) sampling of the woody species in January or February has been carried out. Within each of the sample sites 5×5 m quadrats are sampled in transects across the site. The number of woody individuals are counted in each quadrat and structural details recorded for the stem of each tree or shrub. Canopy cover is estimated as the projected aerial cover of the crown of the woody plants onto the ground.

A comparison between the canopy cover of the 5 sample sites in time and space has been made (Table 1). When plotted on the map of the sample sites (Figure 1), mean percentage canopy cover shows a decrease across the study area. The highest values are obtained for Area E in the west of the study area and the lowest values at Area A. Area E contains many small *Ochna pulchra* shrubs, less than 3 m tall and therefore the woody plant cover is high with a correspondingly low herbaceous cover. Van Rooyen & Theron (1982) estimated basal percentage cover for the herbaceous species in 1975, 1977 and 1980 (Table 2). The mean basal percentage cover for the 5 study sites is also plotted in Figure 1 and a lower cover value of herbaceous plants was recorded in area E although the cover of the herbs in the other areas is more or less consistent. An overall increase in mean herbaceous cover from west to east would have been observed, but for an abnormally low cover recorded in area A. In 1980 the very dry 1978/79 rainy period (Van Rooyen & Theron 1982) resulted in a reduction in herbaceous cover and the areas A and E with shallow soil and rocky outcrops appeared to be particularly affected. Area A showed a reduction of almost 50% basal cover. The differences in canopy cover and density in the different areas may be related to the subassociations of the *Burkea* savanna which have been recognized (Coetzee *et al.* 1976) or the patchiness and pattern of the distribution of woody plants (Lubke *et al.* 1983) but this has not been pursued. Likewise physical factors of the environment which may account for the variation should also be studied in future.

The grand mean of woody canopy cover is 36,5% which is higher than the figure of 27,5% estimated by Van Rooyen & Theron (1977). Over the majority of the study area (areas A – C) the percentage cover varies from 30 – 34% and it is only in the western region that there is a greater cover of woody species. Our estimates are possibly slightly high as they do not allow for the overlap of one tree canopy by another. From field observations I estimate that this would probably amount to values of 1 – 5% greater than the true total woody canopy cover (excluding overlap) depending on the distribution of shrubs and trees in each area. The true overall woody canopy cover may therefore be between 31 and 35%.

The percentage canopy cover has also been related to the total density of woody plants in the study area at the different time periods (Table 3). Rutherford (1981) has made extensive studies on the short-term changes in woody plants at Nylsvley following the fire in 1978. Mortality of the woody plants was found to be very low and basal shoot regeneration was related to plant height and the reduced canopy. There was a particularly marked increase in regeneration of basal shoots in *Ochna pulchra*, the dominant shrub with a reduction in canopy leaf biomass. Fire thus results in a marked increase in density of the woody species (Lubke & Thatcher 1983) and to show how fire affects the density and canopy, the period when fires occurred has been indicated in Table 3. Fire results in the die back of individual shrubs up to about 1,5 m tall and an increase in smaller shrubs as the plants coppice from the base or from the shallow root system.

After the fires in 1978 and 1979 in areas B and A respectively there was a marked increase in total density of woody plants and a corresponding decrease in percentage canopy cover. Thus, a negative correlation between density and canopy cover is recorded in the burnt areas (Table 3) which is significant in the case of area A (Figure 2; $P < 0{,}001$). In the unburnt areas, C and E, there is a positive correlation

between density and canopy cover (Table 3) as the canopy increases with an increase in density or larger shrubs. With respect to area C this correlation is significant (Figure 2; $P < 0,05$). Although area D shows a negative correlation, it is not significant as the canopy cover was increasing along with density up until 1980 and then following the fire of

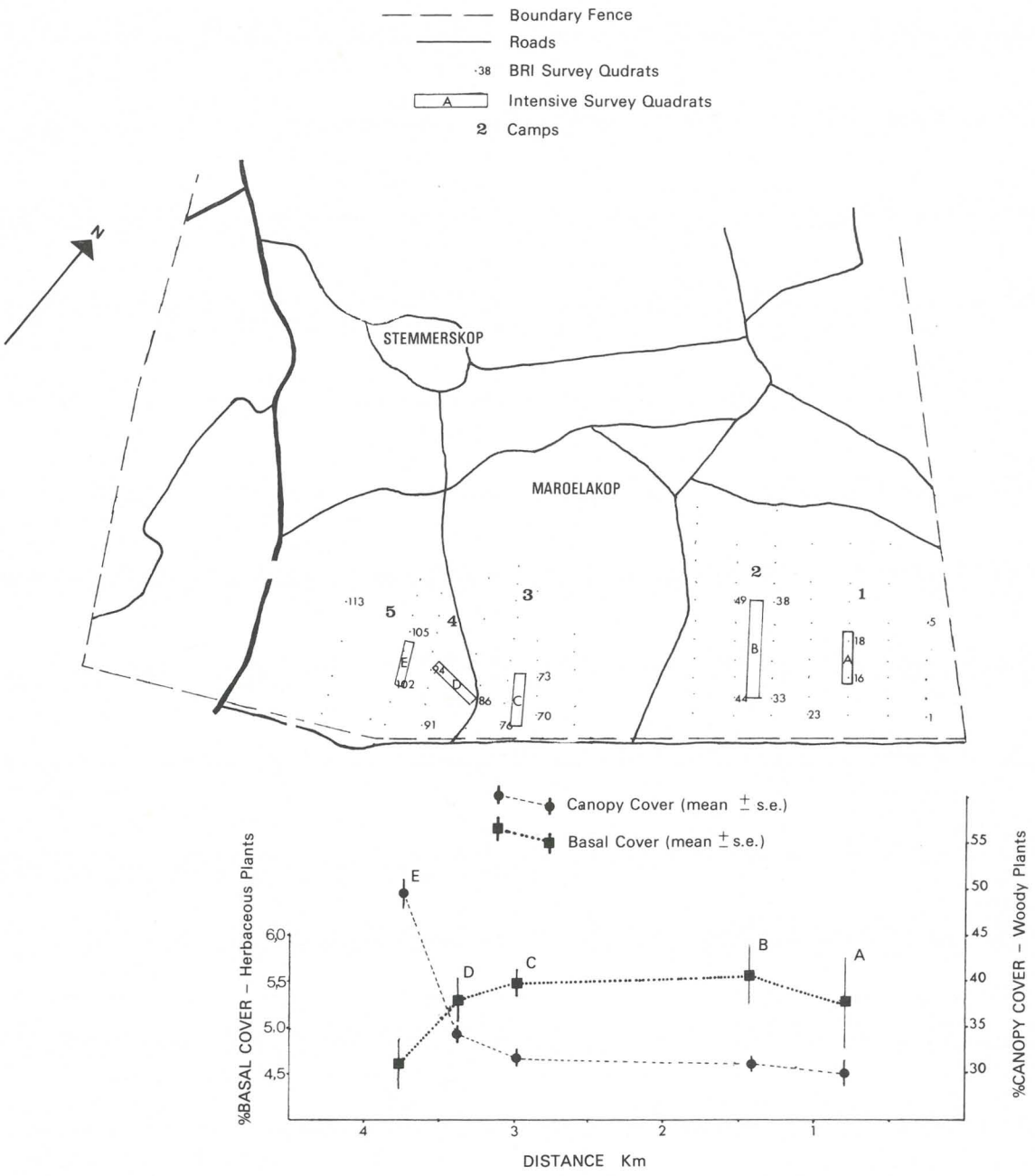

Figure 1 Map of the savanna study site and graph of the mean percentage canopy cover of woody plants (Table 1) and mean basal percentage cover of herbaceous plants (Table 2) in the five study areas.

Table 1 Total canopy cover of all woody species (m^2) and percentage canopy cover

	Areas									
	A		B		C		D		E	
Year	Cover (m^2)	%	Cover (m^2)	%	Cover (m^2)	%	Cover (m^2)	%	Cover (m^2)	%
1976	778,3	38,97	1451,3	36,28	587,4	29,37	452,0	37,67	504,1	42,01
1980	476,8	23,84	1240,2	31,01	739,5	36,98	510,1	42,51	558,1	46,51
1982	546,6	27,33	1143,0	28,58	700,5	35,03	386,1	32,18	718,5	59,88
Total area of sample (m^2)	2000	–	4000	–	2000	–	1200	–	1200	–
Mean % cover (±*S.E.*)	–	30,03 (±4,56)		31,96 (±2,27)		33,79 (±2,28)		37,45 (±2,98)		49,47 (±5,37)

1981 there is a decrease in canopy cover and a continued increase in density. However, because of the small sample size the significance of the correlations is questionable. Their importance should be seen as giving an indication of the trends of density/canopy change with and without fire.

In conclusion, like density and biomass (Lubke & Thatcher 1983), total canopy cover is not a static entity in the savanna ecosystem. Researchers at Nylsvley should be aware of the non-uniformity of woody plant canopy cover across the *Burkea* savanna if this has a bearing on their studies. In the absence of fire there appears to be an increase in canopy cover along with density. Canopy cover of the woody plants varies from 29 to 60% depending on the area or time of recording. In the sites where most studies are made (areas A to C), the canopy cover ranges from 31 to 35%. Under the influence of fire this canopy cover decreases by 5 – 10% depending on the area and then shows an increase with time as the young shrubs grow up and cover a larger area. Furthermore, the interplay between the herbaceous and woody plant cover is an important aspect to consider in the dynamics of savanna vegetation, as the percentage basal cover of herbs varies inversely with the percentage woody canopy cover.

Table 2 Percentage basal cover of the herbaceous species (from Van Rooyen & Theron 1982)

	Percentage basal cover				
Year	Area A	Area B	Area C	Area D	Area E
1975	6,65	5,75	5,10	4,65	5,20
1977	6,05	6,60	5,95	6,20	5,00
1980	3,15	4,35	5,35	5,05	3,50
Mean (±*S.E.*)	5,28 (±1,08)	5,57 (±0,66)	5,47 (±0,25)	5,30 (±0,46)	4,57 (±0,54)

Table 3 Percentage canopy cover compared with the total density of woody plants

Area	Year	% Canopy cover	Total density (plants ha^{-1})	Correlation coefficient
A	1976	38,92	10115	
	Fire			
	1980	23,84	13175	−0,9999*
	1982	27,33	12480	
B	1976	36,28	5612,5	
	Fire			
	1980	31,01	9770,0	−0,636*
	1982	28,58	7532,5	
C	1976	29,37	11815	
	1980	36,98	13805	+0,989
	1982	35,03	13585	
D	1976	37,67	8366,7	
	1980	42,51	14341,7	−0,067*
	Fire			
	1982	32,18	14558,3	
E	1976	42,01	8900	
	1980	46,51	13391,7	+0,679
	1982	59,88	13283,3	

*Burnt areas show negative correlation

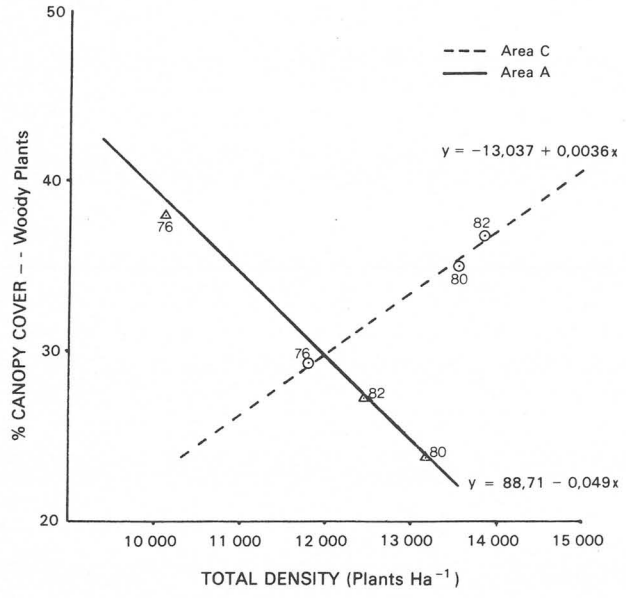

Figure 2 Relationship between total percentage cover and total density of woody plants in areas A (burnt) and C (unburnt) during the years 1976 to 1982.

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